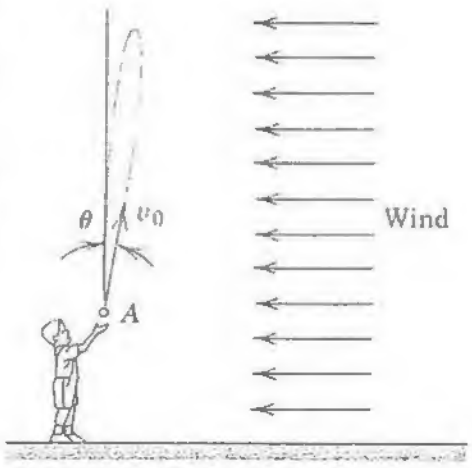
MIE 100 Tutorial Quiz – Wednesday January 19, 2005

A boy throws a ball upwards with a speed of 10 m/s. The wind imparts a constant horizontal acceleration of a_x to the left. Assume that the wind does not affect the vertical motion of the ball.

If the boy must throw the ball at an angle $\theta = 5°$ so that it returns to the point of release, determine the horizontal acceleration of the ball resulting from the wind and the time of flight of the ball.



For constant acceleration a_c:

$$v = v_0 + a_c t \;;\; s = s_0 + v_0 t + \frac{1}{2} a_c t^2 \;;\; v^2 = v_0^2 + 2a_c(s - s_0)$$

Solution:

a)

vertical

$$y = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$$

$$0 = 0 + v_0 \cos\theta t_f - \frac{1}{2} g t_f^2$$

$$t_f = \frac{2v_0 \cos\theta}{g}$$

$$= \frac{2(10)\cos 5°}{9.81}$$

$$= 2.03 \text{ s}$$

horizontal

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

$$0 = 0 + v_0 \sin\theta t_f + \frac{1}{2} a_x t_f^2$$

$$a_x = \frac{2v_0 \sin\theta}{t_f}$$

$$= \frac{2v_0 \sin\theta}{2v_0 \cos\theta} g$$

$$= g \tan\theta$$

$$= (9.81)\tan 5°$$

$$= 0.858 \text{ m/s}^2$$